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Design and Development of Arduino based Nutrient Film Technique System

Dr. Nilesh R. Kharche[1], Ajay Maruti Jadhav[2], Akash Prakash Ingle[3], Shubham Aditya Khedkar[4], Sagar Vasant Ghule[5]

[1,2,3,4,5]*Department of Mechanical Engineering, Dr. D Y Patil School of Engineering And Technology, Pune, Maharashtra, India*

Abstract: ***Hydroponics is a new agricultural production system in which the production takes place in a soilless medium using water. The hydroponic system requires controlled environment for the proper growth of plants, less chance of diseases and faster growth. It includes Automated Monitoring and controlling environmental parameters like temperature, humidity, Light timing, etc. The parameters are acquired by the respective sensors. The key objective of this paper is to present low-cost Smart Hydroponic System using Nutrient Film Technique (NFT) with Arduino UNO to design and implementation of a control system for a hydroponic system to control the flow of nutritious solutions in growth channels. The controller is based on the Arduino Uno controller. using this technique we can grow plants like green leafy vegetables, tomatoes, cucumber, peppers etc. without any harmful pesticides and fertilizers.***

Keywords: Hydroponic System; Nutrient Film Technique(NFT); Arduino Uno; Soil-Less Cultivation; Nutrient Solution; pH; EC; wireless communication.

I. INTRODUCTION

Hydroponics is a method of growing plants using mineral Nutrients solutions in Water without soil. Hydroponics technique is the best way to grow vegetables, fruits, plants without soil. Hydroponics can be grown outdoors, indoors even in small space. Hydroponic allow for the crop to grow in the area where Growing traditionally has been a problem and the place where the soil is poor in terms of fertility and where water is minimum, where farmland is too expensive. In Hydroponics techniques plants are placed in growing medium and nutrients are delivered directly to roots. Plant May grow with their roots in nutrient solution only or in an inert medium. The hydroponic technique is better, faster way to grow plant than the growing plants in soil. Hydroponic provides better, the more nutritional result with the efficient use of water and fertilizer. Hydroponics allow farmers to grow more food in less space as compared to traditional Soil gardening. Vegetables, plants, and flower can be grown on the roof of houses. Fruits grow in a shorter period of Time as compared with soil system.

There are six main types of hydroponic systems.

Wick Systems
Deep Water Culture (DWC)
Nutrient Film Technique (NFT).
Ebb and Flow (Flood and Drain)
Aeroponics
Drip Systems

A. NFT System

The NFT system (Nutrient Film Technique) is quite popular with home hydroponic growers as well. Mainly because of it is fairly simple to design. However, NFT systems are best suited for, and most commonly used for growing smaller quick growing plants like different types of lettuce. Along with growing lettuce, some commercial growers also grow different types of herbs and baby greens using NFT systems. While there is a lot of different ways design the system. They all have the same characteristic of a very shallow nutrient solution cascading down through the tubing. Where the bare roots of the plants come in contact with the water and can absorb the nutrients from it as shown in Fig 1.

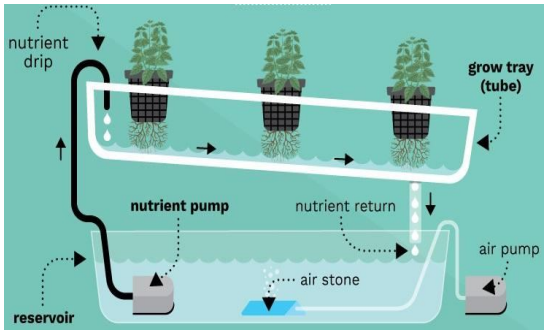

Fig-1 NFT system

B. Arduino UNO

The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts.

Fig 2. Arduino UNO SMD R3

II. LITREATURE REVIEW

NFT increases growing area of cultivation. Very less area required for farming. Number of crop can be cultivated in this concept. Effect of flood in conventional farming is high as compare to vertical farming. Due to heavy rain possibility of water logging is more in case of conventional farming but it can be reduce by applying concept of Vertical farming. One biggest problem in Horizontal farming is erosion of soil of farm as time goes. But in case of NFT use of soil is nil.

Following points are very important to know whyvertical farming is needed:

A. Reliable Harvests

As space used is less, wastage of seed would be neglected. And so it will be reliable to farmer and common public to do NFT at their places. After investing initial money with minimum maintenance so it will be one time investment plan.

B. Minimum Overheads

NFT need small space for cultivation. Once money invested than after cultivation it will be earned in just 3 to 4 cultivation as structure is built up to number of storey. So finally what revenue earned is more than the investment. minimum overhead is reduces in the case of NFT.

C. Increased Growing Area

In very small area NFT is possible and it will increases growing area. If land having 50 m area is cultivated for two months of crop period, more yield can be expected if six panels each containing three cultivation floor of 5 m area individually, with cultivation area of 90m2.

D. Wide Range of Crop

Any kind of crop is possible in NFT. As preventing crop from rain shed will possible to construct on the structure so summer crop is also possible in rainy season in a NFT system.

III. HARDWARE

A. Temperature Sensor

Lm35 can measure from -55 degree centigrade to 150 degree centigrade. The accuracy level is very high if operated in at optimal temperature and humidity levels. Conversion of output voltage to centigrade is also easy and straight forward. Input voltage to lm35 can be from +4 volts to 30 volts. It consumes about 60 micro amperes of current. As shown in fig. 3.

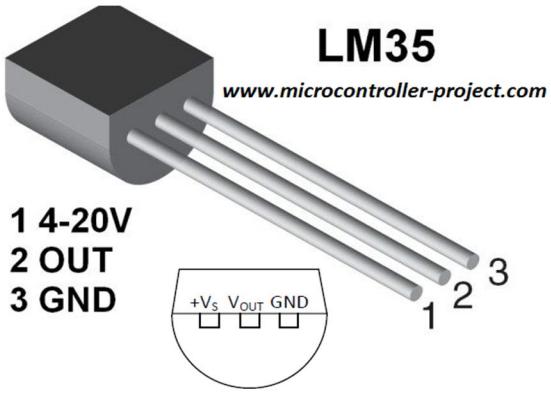

Fig. 3. Temperature Sensor

B. Buzzer

There are two types are buzzers that are commonly available. The one shown here is a simple buzzer which when powered will make a Continuous Beeeeeeppp.... sound, the other type is called a readymade buzzer which will look bulkier than this and will produce a Beep. Beep. Beep. Sound due to the internal oscillating circuit present inside it. But, the one shown here is most widely used because it can be customised with help of other circuits to fit easily in our application. As shown in fig. 4.

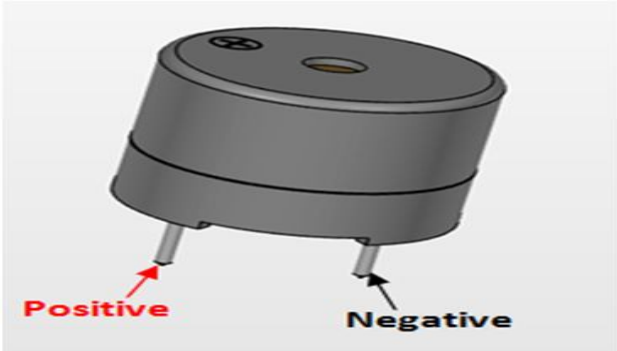

Fig.4: Buzzer

C. LCD Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A **16x2 LCD** means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. As shown in fig.5

Fig. 5

D. Bluetooth Module

To communicate smartphone with HC-05 Bluetooth module, smartphone requires Bluetooth terminal application for transmitting and receiving data. As shown in fig 6

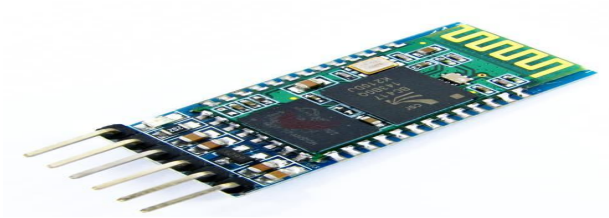

Fig. 6 : Bluetooth Module

E. NFT System Model

The model used is a stack type NFT model. It consists of 3 layers of draft tubes one above the other vertically. The draft tubes are made of PVC material and the frame supporting it is made of iron bars which are welded in to a pyramid like structure. The draft tubes which is grow bed have 5 holes of 2 inches on each layer which are occupied with net cups, responsible for holding the plant in which sand balls being the holding media. All three layers connected together by small PVC pipe and elbow connectors.

Fig.7: constructed model

IV. SOFTWARE USED

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, mac OS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards. The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main()* into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program *avrdude* to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

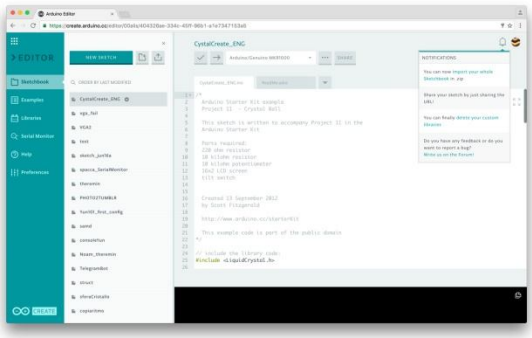

Fig.8: home screen

V. WORKING OF SYSTEM

In Automated Hydroponic system plants are placed in a growing medium and nutrients are delivered directly to the roots. Arduino UNO SMD R3 is the main part of the automated hydroponic system. The Arduino is used for monitoring and controlling the parameters like Temperature and controlling lights. To indicate the rise in temperature of the system buzzer has been fitted into the system which alerts the rise in temperature. hydroponic grow lights have been mounted in the system which operates on timer setting as instructed to Arduino. We have to also maintain pH and conductivity into the nutrients tank for that pH up, pH down solution, nutrients solution has been provided with manual dosing action into nutrient tank so proper pH and conductivity will be maintained. We have used HC-05 Bluetooth module to communicate with smartphone. The home screen of the software used is shown in Fig-8.

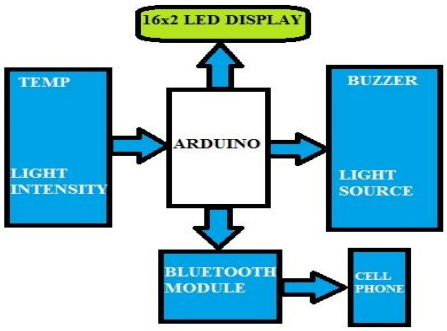

Fig.9: block diagram of system.

As shown in Fig 9 Arduino Unit consists of Arduino uno kit, LCD display, Bluetooth module, Temperature sensor and grow light. The output is shown on the cell phone in an android application and can be controlled wirelessly.

VI. CONCLUSION

In this paper was presented an automatic system for hydroponic NFT system for leafy vegetables production. The three storey system produces 15 units of plants for day. The production is constant over the 365 days of the year, at a monitored high quality level. The development of a project like the one presented here shows the goals that can be accomplish when it is realized with an interdisciplinary team. As a result, several ideas have surge to extend the project to the growth of different kind of plants. In must be noted that each plant depends of different factors or variables and hence they demand different control strategies such as Ph. Temperature, levels of light, humidity, etc. The future work includes the design of PH and humidity control system which are also very important variable for hydroponic systems. A disadvantage of these systems is that the calibration of the whole system takes a lot of time because of the time the plants takes to grow.

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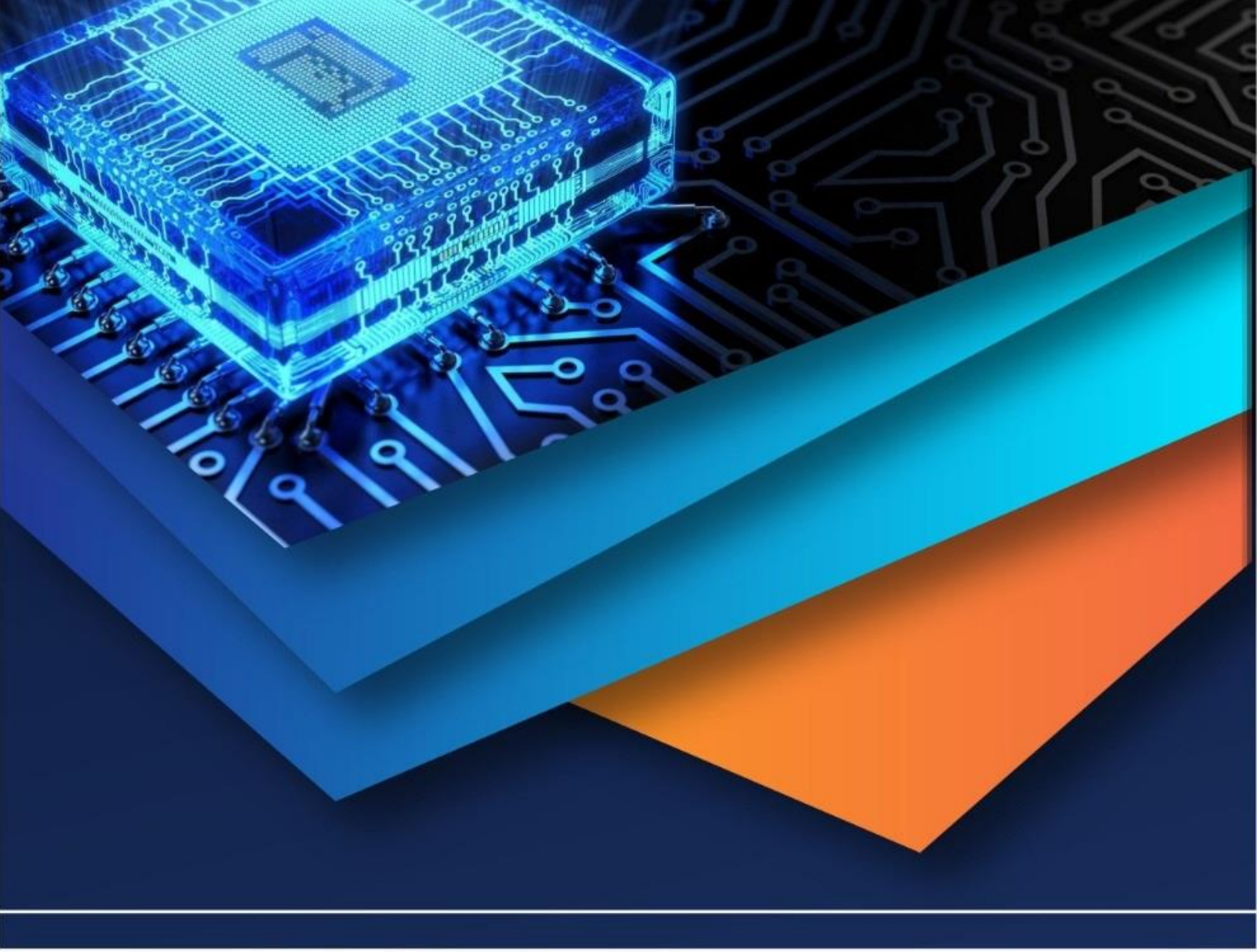

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